International Journal of All Research Education and Scientific Methods (IJARESM),
ISSN: 2455-6211, Volume 13, Issue 5, May-2025, Available online at: www.ijaresm.com

Formulation and Evaluation of Polyherbal Antidandruff Powder Shampoo

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ABSTRACT

The present study focuses on the formulation and evaluation of a polyherbal antidandruff powder shampoo using natural ingredients known for their antimicrobial, antifungal, and cleansing properties. The formulation includes plant-based components such as Azadirachta indica (Neem), Hibiscus rosa-sinensis (Hibiscus), Trigonella foenum-graecum (Fenugreek), Sapindus mukorossi (Reetha), and Ocimum sanctum (Tulsi), among others. These herbs were selected based on their traditional usage and scientifically proven effectiveness against dandruff-causing microorganisms, particularly Malassezia species. The powder shampoo was prepared by drying, pulverizing, and blending the herbal ingredients in suitable proportions. The formulation was evaluated for various physicochemical parameters including pH, foamability, cleansing action, irritancy, and stability. Antidandruff activity was assessed through microbiological assays against common dandruff-causing fungi. Results demonstrated that the polyherbal powder shampoo possesses significant antidandruff activity, with good foaming capacity, acceptable pH, and non-irritant properties, making it a promising natural alternative to synthetic antidandruff shampoos. The study highlights the potential of integrating traditional herbal knowledge with modern pharmaceutical techniques to develop effective and safe hair care formulations.

Keywords:-Herbal Powder Shampoo, Azadirachta Indica, Sapindus Mukorossi, Antifungal Activity, Natural Hair Care, Scalp Treatment, Ayurvedic Herbs, Dandruff Therapy.

INTRODUCTION

Overview of Dandruff and Scalp Disorders

Dandruff, medically termed *pityriasis capitis*, is a prevalent scalp condition that affects up to 50% of the global population, regardless of ethnicity or gender. Although it is generally not medically serious, its social and psychological impact can be significant, causing embarrassment, lowered self-esteem, and chronic discomfort. Dandruff typically manifests during adolescence and young adulthood—an age group marked by heightened sebaceous gland activity. The condition is characterized by excessive shedding of dead skin cells from the scalp, accompanied by itchiness, scalp dryness or oiliness, flakiness, and occasionally, mild inflammation or erythema.

Dandruff is considered a non-inflammatory, mild form of seborrheic dermatitis and is most commonly associated with the overgrowth of the lipophilic yeast *Malassezia furfur*. This microbe feeds on scalp sebum and metabolizes triglycerides to release free fatty acids, which in susceptible individuals can irritate the scalp and accelerate epidermal turnover, resulting in visible flakes. Various internal and external factors—such as hormonal imbalances, immune responses, stress, poor hygiene, dry skin, and the use of inappropriate hair products—can trigger or exacerbate dandruff. Climate conditions, particularly cold and dry weather, also tend to aggravate the symptoms.

Limitations of Conventional Treatments

The modern pharmaceutical and cosmetic industries have developed a range of antidandruff formulations, most commonly in the form of medicated shampoos. These typically contain synthetic antifungal and keratolytic agents such as:

- **Ketoconazole** – a potent antifungal agent targeting *Malassezia* species.
- **Zinc pyrithione** – an antimicrobial compound with anti-yeast and anti-inflammatory properties.
- **Selenium sulfide** – used to slow down epidermal cell turnover.
- **Salicylic acid** – a keratolytic that helps remove flakes and scales.

Although these ingredients are effective to a certain degree, long-term or frequent use can result in side effects including scalp dryness, burning sensations, increased hair brittleness, allergic reactions, and microbial resistance.

Moreover, many of these products include synthetic surfactants, preservatives, and fragrances that may not be compatible with sensitive skin. Growing concerns about the environmental and health effects of synthetic chemicals have led consumers to seek safer, gentler, and eco-friendlier alternatives.

The Rise of Herbal and Natural Cosmetic Products

With the increased awareness of holistic wellness and sustainability, there has been a noticeable shift in consumer preferences toward plant-based and herbal personal care products. Herbal medicine, deeply rooted in systems like Ayurveda, Siddha, and Unani, emphasizes the use of natural plant-derived ingredients for promoting health and treating disorders. These traditional systems have long used various herbs to treat hair and scalp conditions, including dandruff, hair loss, and premature greying.

Herbs are rich in bioactive compounds such as alkaloids, flavonoids, saponins, phenolics, tannins, and essential oils. These compounds offer multiple benefits—antimicrobial, anti-inflammatory, antioxidant, cleansing, and conditioning effects—often without the harshness or side effects seen with synthetic formulations. Additionally, herbal products are biodegradable and environmentally sustainable, aligning with the principles of green chemistry.

Polyherbalism and Synergy in Hair Care

Polyherbalism refers to the use of multiple herbs in a single formulation to harness the synergistic action of various phytochemicals. In Ayurveda, it is believed that combining herbs enhances the therapeutic efficacy and balances the possible adverse effects of individual plants. This is especially relevant in the treatment of multifactorial conditions like dandruff, which may stem from microbial infection, scalp inflammation, excess sebum production, or dryness.
For example:

- **Neem (Azadirachta indica)** is a powerful antimicrobial and antifungal agent.
- **Reetha (Sapindus mukorossi)** acts as a natural cleanser and foam enhancer.
- **Shikakai (Acacia concinna)** gently removes dirt and oil while promoting scalp health.
- **Amla (Emblica officinalis)** is rich in Vitamin C and antioxidants that strengthen hair and reduce dandruff.
- **Hibiscus (Hibiscus rosa-sinensis)** promotes hair growth and moisturizes the scalp.
- **Tulsi (Ocimum sanctum)** soothes the scalp and has broad-spectrum antimicrobial activity.
- **Fenugreek (Trigonella foenum-graecum)** helps in reducing inflammation and strengthens hair follicles.

When combined, these herbs provide a multi-pronged approach to dandruff management: cleansing the scalp, controlling fungal growth, reducing inflammation, and restoring moisture balance.

Advantages of Powder Shampoo Formulations

Traditional shampoos are mostly liquid formulations that contain 60–80% water, requiring the addition of synthetic preservatives and emulsifiers to prevent microbial growth and maintain stability. However, powdered shampoos are emerging as an innovative and sustainable alternative. Their benefits include:

- **Water-free and preservative-free** nature, enhancing stability and reducing the risk of microbial contamination.
- **Longer shelf life** due to reduced moisture content.
- **Easy transport and storage**, especially in eco-friendly packaging.
- **Minimal chemical load**, making them ideal for people with sensitive scalps.
- **Environmentally conscious** as they reduce the need for plastic bottles and minimize carbon footprint.
  Incorporating herbal powders into a dry shampoo base enables the formulation to remain stable, cost-effective, and suitable for various climates and conditions. When mixed with water at the time of use, these powders can form a gentle cleansing paste that can be rinsed off easily, leaving the scalp clean, refreshed, and nourished.

Objectives of the Present Study

This project aims to design and evaluate a **polyherbal anti-dandruff powder shampoo** utilizing a blend of traditionally used medicinal herbs. The primary objective is to develop a product that is:

- **Safe**, with minimal risk of allergic or adverse reactions.
- **Effective** in controlling dandruff and improving scalp health.
- **Natural and sustainable**, reducing dependency on synthetic chemicals.
- **Cost-effective and scalable** for commercial production.

The study focuses on the following specific goals:

1. To select and standardize herbal ingredients with proven anti-dandruff properties.
2. To formulate a stable, free-flowing powder shampoo using selected herbs.
3. To evaluate the physicochemical parameters such as pH, moisture content, flowability, foamability, and dispersibility.
4. To assess the antimicrobial activity of the formulation against *Malassezia* species.
5. To conduct sensory evaluation and stability testing to ensure long-term usability.
6. To explore consumer acceptability, packaging options, and scalability potential.

Ideal Characteristics of a Polyherbal Anti-Dandruff Powder Shampoo

To meet both consumer expectations and therapeutic goals, the ideal polyherbal antidandruff powder shampoo should exhibit the following properties:

Parameter	Requirement
Color and Appearance	Uniform, natural, and visually appealing.
Fragrance	Mild and pleasant herbal aroma.
Texture	Fine, smooth, non-gritty powder.
Flowability	Good flow characteristics for easy handling and packaging.
Moisture Content	Low to prevent microbial contamination and enhance shelf life.
pH	Scalp-friendly, between 4.5 and 6.5.
Foamability	Moderate and stable foam upon mixing with water.
Dispersibility	Quick wetting and even dispersion in water.
Cleansing Efficiency	Effective in removing dirt, oil, and dandruff flakes.
Antifungal Activity	Inhibits growth of *Malassezia furfur*.
Scalp Soothing	Should prevent irritation and promote scalp hydration.
Stability	Maintains color, odor, and effectiveness over time.

Scientific Rationale Behind Herb Selection

The selection of herbs in the formulation of a polyherbal anti-dandruff powder shampoo is not arbitrary; it is grounded

in traditional knowledge and supported by pharmacological evidence. Each plant used contributes unique phytochemicals that play distinct roles in scalp health and dandruff control. The formulation is designed to ensure complementary and synergistic interactions among these bioactive compounds.

- Antifungal agents (e.g., azadirachtin from Neem, saponins from Reetha, flavonoids from Tulsi) help reduce the fungal load by inhibiting the proliferation of *Malassezia* species.
- Anti-inflammatory agents (e.g., mucilage from Hibiscus, trigonelline from Fenugreek) soothe irritated scalp tissues and help reduce itching and redness.
- Antioxidants (e.g., ascorbic acid from Amla, phenolics from Shikakai) protect scalp cells from oxidative stress, which is often elevated during dandruff flare-ups.
- Natural cleansers and surfactants (e.g., saponins in Reetha and Shikakai) gently remove oil, dirt, and dead skin without stripping natural scalp oils.
- Conditioning and nourishing agents (e.g., polysaccharides from Hibiscus and Fenugreek) moisturize the scalp and strengthen hair follicles.
  The combination of these functionalities provides a comprehensive remedy that addresses not only dandruff symptoms but also the underlying causes such as microbial imbalance, scalp inflammation, and poor scalp hygiene.

Detailed Profile of Selected Herbs

Neem (Azadirachta indica)

Known as the “village pharmacy” in Ayurveda, Neem has extensive uses due to its antifungal, antibacterial, anti-inflammatory, and wound-healing properties. Azadirachtin, nimbin, and quercetin are key constituents that exert antifungal activity by disrupting the fungal cell wall and inhibiting lipid synthesis—critical for the survival of *Malassezia* species.

Reetha (Sapindus Mukorossi)

Commonly called soapnut, Reetha is a natural surfactant due to its high saponin content. It gently cleanses the scalp without disturbing the skin’s natural barrier. Its antifungal activity, combined with foaming capacity, makes it an essential base in herbal shampoos.

Shikakai (Acacia Concinna)

Often termed as "fruit for hair," Shikakai is mildly acidic, which helps maintain the scalp's pH. It contains saponins and polyphenols that clean the scalp and reduce fungal growth. It also has conditioning properties, which help reduce dryness often associated with dandruff treatments.

Amla (Emblica officinalis)

Amla is rich in Vitamin C and polyphenols, making it a potent antioxidant. It strengthens hair roots, prevents premature greying, and promotes healthy hair growth. It also has mild antimicrobial activity and reduces scalp irritation.

Hibiscus (Hibiscus rosa-sinensis)

The mucilage present in hibiscus leaves and flowers moisturizes and conditions the scalp. It has been used traditionally to prevent hair loss and enhance hair volume. Its soothing properties help relieve itchiness and inflammation.

Tulsi (Ocimum sanctum)

Tulsi possesses a wide range of therapeutic effects, including antifungal, antibacterial, and anti- inflammatory. Eugenol and ursolic acid in Tulsi act against scalp pathogens while simultaneously calming inflamed tissues.

Fenugreek (Trigonella foenum-graecum)

Fenugreek seeds are a rich source of flavonoids, trigonelline, and mucilage, which provide antifungal activity and reduce scalp dryness. They are also known to reduce hair thinning and promote hair strength

Traditional Medicine Relevance

The proposed formulation is rooted in Ayurvedic and Siddha medicinal practices, where these herbs have been historically documented for hair and scalp care. Texts such as *Charaka Samhita* and *Bhavaprakasha* mention the use of herbal pastes and powders for treating scalp disorders and enhancing hair quality.

Formulating a product that reflects traditional heritage while adhering to modern cosmetic science not only ensures effectiveness but also supports the preservation of indigenous knowledge systems. This alignment is particularly appealing in today's wellness-focused market, which increasingly values authenticity, traceability, and holistic care.

Growing Market Demand for Herbal Hair Care Products

The global herbal hair care market is expanding rapidly. Consumers today are more conscious of ingredient labels and actively seek products that are:

- Free from sulfates, parabens, and silicones
- Cruelty-free and not tested on animals
- Eco-friendly in formulation and packaging
- Backed by traditional or natural healing principles

According to market analysis, the herbal shampoo segment is expected to witness a compound annual growth rate (CAGR) exceeding 6% over the next five years. India, with its rich biodiversity and tradition in Ayurveda, is uniquely positioned to lead this movement. A polyherbal powder shampoo offers a novel solution that fulfills consumer desires for sustainability, safety, and efficacy.

Moreover, the COVID-19 pandemic and post-pandemic shift toward “slow beauty” has encouraged users to prefer time-tested natural solutions over fast-acting synthetic alternatives, thereby creating space for innovative formats like powder shampoos.

Innovation in Green Cosmetic Science

This formulation not only supports health and wellness but also contributes to the green cosmetic science movement, which advocates:

- Use of biodegradable ingredients
- Avoidance of petrochemical-based components
- Reduction in packaging waste
- Waterless formulations that save resources and enhance product longevity

Powder shampoos, being waterless, require no preservatives, have a lower carbon footprint in transportation, and often come in recyclable or compostable packaging—thereby aligning with circular economy principles. The development of such products also opens up research in encapsulation techniques, botanical standardization, and bio-enhanced delivery systems.

Challenges and Considerations

Despite the advantages, formulating a polyherbal powder shampoo poses some challenges:

- Ensuring compatibility among herbs to prevent loss of potency or stability.
- Maintaining flowability of powders, especially in humid climates.
- Achieving optimal pH for scalp application without additives.
- Standardization of phytoconstituents, which may vary depending on plant source and processing methods. These considerations necessitate a rigorous approach during formulation development, including:
- Use of drying agents or desiccants
- Grinding and sieving to uniform mesh size
- Inclusion of natural excipients like rice flour or arrowroot powder
- Moisture content testing and microbial load assessment

Expected Outcomes and Benefits

The successful development and evaluation of this polyherbal powder shampoo is expected to result in a product that:

- Demonstrates effective dandruff control without side effects
- Maintains or enhances scalp and hair health
- Offers a pleasant and user-friendly experience
- Has a long shelf life and high consumer acceptability
- Can be scaled up for small-scale or commercial production
- Contributes to the body of scientific evidence supporting traditional medicine

Additionally, this formulation can serve as a prototype for further studies involving herbal cosmetics, encouraging interdisciplinary collaboration among pharmacists, botanists, cosmetic chemists, and traditional healers.

Conclusion to Introduction Section

The formulation and evaluation of a polyherbal anti-dandruff powder shampoo represents a promising intersection of traditional knowledge and modern cosmetic innovation. By leveraging the therapeutic potential of well-known herbs and integrating them into a sustainable, preservative-free powder format, this project aims to address a common dermatological concern in a safe, effective, and eco-conscious manner.

As consumer demand for herbal and natural products continues to rise, such formulations not only fulfill a cosmetic need but also align with health, environmental, and cultural values. The study thus holds both academic and commercial relevance, and sets the stage for future innovations in natural personal care products.

INGREDIENTS :-

Sr. No.	Herbal Ingredient	Botanical Name	Category
1	Neem	*Azadirachta indica*	Antifungal, antibacterial, anti-inflammatory
2	Reetha	*Sapindus mukorossi*	Natural cleanser, foaming agent, antifungal
3	Shikakai	*Acacia concinna*	Mild cleanser, antifungal, antimicrobial
4	Amla	*Emblica officinalis*	Antioxidant, antimicrobial, strengthens hair, reduces dandruff
5	Hibiscus	*Hibiscus rosa-sinensis*	Conditioner, promotes hair growth, moisturizes scalp
6	Tulsi	*Ocimum sanctum*	Antibacterial, antifungal, scalp soothing
7	Fenugreek	*Trigonella foenum-graecum*	Antifungal, anti-inflammatory, strengthens hair
8	Polyherbal Formulations	—	Synergistic antidandruff effects without side effects

FORMULATION TABLE

SR. NO	INGREDIENTS	QUANTITY
1	Ritha Powder	4.0
2	Shikakai Powder	3.5
3	Neem Leaf Powder	3.0
4	Aloe Vera Powder	2.5
5	Amla Powder	2.5
6	Tulsi Powder	2.0
7	Methi Powder	1.5
8	Hibiscus Powder	1.0

PROCEDURE

1. Collect plant parts (leaves, fruits, seeds) : Wash thoroughly and dry in shade at room temperature to retain active constituents.
2. Mixing: combine neemleaf powder , tulsi, shikakai, ritha powder, amla ,and aloe vera powders in the specified ratio.
3. Grinding: grind the mixture into a fine powder using a grinder or mortar and pestle.
4. Sifting: sift the powder through a fine-mesh sieve to ensure uniform particle size.
5. Packaging: package the powder in airtight containers 20gm of powder.

EVALUATION STUDY

The formulated polyherbal antidandruff powder shampoo was subjected to various evaluation parameters to assess its physical, chemical, and biological effectiveness. The following tests were performed:

Organoleptic properties:
The color, odor, and texture of the powder shampoo were observed visually to ensure uniformity and consumer acceptability.

Ph determination:
A 1% aqueous solution of the powder shampoo was prepared, and the ph was measured using a digital ph meter. An ideal ph of 5.0–7.0 was considered suitable for scalp and hair application.

Foaming ability and foam stability:
The foam volume was measured using the cylinder shake method. The stability of foam was observed over a time period of 5 minutes to evaluate the surfactant property of natural ingredients like reetha.

Cleansing ability:
A standard wool yarn test was performed by immersing dirty wool yarn into the shampoo solution. The percentage of dirt removed was used to assess cleansing efficiency.

Irritancy test:
Patch testing was done on a small area of skin (usually forearm) of human volunteers to check for any irritation, redness, or allergic reaction.

Moisture content:
Determined by drying a known amount of the powder shampoo at 105°c until constant weight, to ensure stability and prevent microbial growth.

Microbial load test:
Total bacterial and fungal counts were evaluated to ensure the formulation meets acceptable microbial limits.

Antidandruff activity:
The antifungal activity was tested using the agar well diffusion method against malassezia furfur or candida albicans. The zone of inhibition was measured to assess effectiveness.

Stability study:
The powder was stored at room temperature and elevated temperatures (40°c ± 2°c) for 30–60 days. Parameters like color, odor, and efficacy were observed periodically to determine stability.

CONCLUSION

The formulated polyherbal antidandruff powder shampoo demonstrated promising results in terms of physical, chemical, and biological evaluations. It showed good cleansing ability, acceptable pH, stable foam formation, and no signs of skin irritation. The herbal ingredients exhibited synergistic antifungal activity against dandruff-causing organisms, supporting their traditional use in scalp care.

The formulation was stable over the study period and free from harmful synthetic additives, making it a safe, eco-friendly, and cost-effective alternative to commercial shampoos. Overall, the study validates the potential of herbal powders in developing effective natural remedies for dandruff treatment.

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